



PERU HEALTHY KITCHEN/HEALTHY STOVE PILOT PROJECT



ANNEX III – Indoor Air Pollution Monitoring Protocol

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Compiled by:

Winrock International

I. Monitoring Methods and Measurements

Objective: To monitor the changes in indoor concentrations of Respirable Suspended Particulates (PM₄) and carbon monoxide (CO) before and after the Healthy Kitchen/Healthy Stove household energy intervention in the kitchens of 40 families in the Inkawasi district, at approximately 12-month intervals to ensure similar conditions exist for the measurements. Swisscontact will conduct a baseline diagnosis to determine the current air quality situation, and follow-up measurements to produce an assessment of the percentage of PM₄ and CO concentration reduction in the kitchens after one year.

The PM monitoring will be conducted using the gravimetric pump-and-filter approach, and a real time, data-logging CO sampler for area concentrations. Based on recommendations from WHO, US EPA, and the UC Berkeley team, personal CO monitoring will not be conducted.

| | | |
|------------------------|---|------------------------------------------------------------------|
| Pump type | : | Buck VSS -5 |
| Filter type | : | PVC, 5 µm, 37mm |
| Flow rate | : | 2.2 l/min ± 5% |
| Flow rate calibration | : | M-5 Mini-Buck calibrator |
| Cyclone type | : | BGI (HD type), 50% cut-off at 4µm |
| CO sampler | : | T82 real time Datalogger |
| Area sampling location | : | area sampling at height 1.3m, and distance 1.3m away from stove |
| Area sampling duration | : | 24 hrs (with a filter change between 2 sessions; see section II) |

Notes:

1. Volume sampled will be calculated using initial and final flow rates measured by the Buck calibrator and time recorded by an external watch. Flow rates, times, and volumes recorded by the pump are to be used only as cross-checking measures.
2. Filter weighing QA/QC: 1 in 10 filters to be used as lab blank and 1 in 10 filters to be used as field blanks. Lab blanks (in cassettes) are to be left in the custody of the designated weighing laboratory. Field blanks will be taken to the field and returned after all 30 houses have been surveyed. Thus we will have 6 lab blanks and 6 field blanks. The laboratory will be requested to give us all raw data (e.g., if a filter is weighed three times, then we need all three readings and not just the average). The laboratory could weigh in batches of 12 – the 11th filter is to be a lab blank and the 12th filter to be the field blank. Filters with more than 2 mg dust loading will be rejected.
3. Data downloaded from T82 to be carefully archived in the laptop. Each file to be labeled in a manner that it is easy to understand which household it relates to. In the first round of analysis we will use only 24-hour averages. But in the second round we will need to look at the time-series profile.
4. Ideally, try to begin monitoring at approximately the same time of day in each house and at least half an hour after the last time cooking occurred in the house.

II. PM and CO Equipment

Two “kits” (equipment cases) have been packed with the following equipment:

- ❑ 1 pump (AP Buck, VSS-5)
- ❑ 1 respirable dust cyclone
- ❑ 2 “triple charge” batteries (VSS/Basic Battery Pack)
- ❑ 1 “Fast One” battery charger with “alligator clips” (for charging pump battery from car battery)
- ❑ 50 filter and 50 support pads, pre-loaded into the 3-part cassette cases with blue and red end plugs (filters to be pre-weighed and assembled by Supervisor)
- ❑ 1 T82 CO monitor with leather case

Case I holds the following additional equipment:

- ❑ 1 calibrator (AP Buck) with charger, plastic tubing, and calibration soap bubbles

Case II holds the following additional equipment:

- ❑ Bottle of 100 shrink bands for filter cassettes
- ❑ T82 Datalogging kit with cable, cradle, and software

Equipment to be acquired locally:

- ❑ Two (2) car batteries, with the following specifications: DELCO, 50 Amp-hour (Ah). Battery life calculations are based on 50 Ah; if other battery capacity is used, please inform Winrock.
- ❑ Two 12 Ampere chargers for charging the car battery from 110 Volt, AC source (if this is not easily available, please inform Winrock).
- ❑ A jumper cable if there will be no access to a 110 Volt AC electricity source, so that the car battery may be charged with the battery in a truck or other vehicle.
- ❑ Materials for securing the pump, cyclone, and T82 in suitable position in the home.
- ❑ Watch or clock for recording start/finish time. NOTE: be sure to synchronize with the equipment to avoid discrepancies!
- ❑ Tape measure for proper location of equipment.
- ❑ Flashlight(s).

III. Monitoring Session Scheduling

The supervisor must schedule the timings of the two sessions such that **one of them does not include any cooking activity** (typically, this will start late in the evening after dinner and end the next day early morning before breakfast). This will provide important information on the background level of particulates. It is not necessary that both the monitoring sessions be of 12 hours duration (meaning that the filter need not be changed exactly after 12 hours).

For example, suppose these are the likely timings as reported by a cook:

Day 1

| | |
|-----------|------------------|
| Breakfast | 6-7 AM |
| Lunch | 11 AM - 12:30 PM |
| Dinner | 8-9 PM |

Day 2

| | |
|-----------|-----------------|
| Breakfast | 6 –7 AM |
| Lunch | 11 AM -12:30 PM |
| Dinner | 8-9 PM |

In this case the supervisor should schedule the monitoring as follows*:

Start the first session on Day 1 at 5:30 AM

End first session on Day 1 at 9:30 PM

Start second session on Day 1 at 9:30 PM (**30 minutes after cooking has ended**)

End second session on Day 2 at 5:30 AM

NOTE 1: For this case, the duration of first session is 16 hours and duration of the second session is 8 hours. This is acceptable. The two durations can be unequal as long as they add up to 24 hours (other than a few minutes that are required to change the filter).

The one risk of this schedule in kitchens with very high concentrations of smoke is that the filters will become quite clogged or even saturated after the 3 (or more) cooking sessions. This can cause back-pressure on the pump, which will make the pump work harder to keep the flow rate constant, and will draw down the battery more quickly. If the back pressure is sufficiently high, the pump may stop. The supervisor should be attentive to this possibility, and should revert to a 12 hour/12 hour monitoring session breakdown in the case of pump stoppage.

***NOTE 2: Monitoring session scheduling is further influenced by battery charging requirements, as discussed in the next section.**

IV. Battery Charging Protocol

Operating Parameters:

- The “triple pack” batteries for the pumps **should be re-charged after every 24-hour monitoring period.** Using the car battery and the “fast charger,” this can be done in approximately 4.5 hours.
- Assuming the car battery is of 50Ah capacity, it can recharge the triple packs 10 times before it will need to be recharged from either:
 1. A 110 volt/AC electricity supply. (This will take approximately 4 hours with a 12 Ampere charger, or about 12 hours with a 4 Ampere charger.) **OR,**
 2. Another car battery. In order to avoid draining the charged car battery, this should be done with the vehicle running, and will take approximately 1 hour.

Recommended Charging Regimen:

1. For every 24-hour monitoring period, use two triple charge batteries to run the pumps. During this time, charge the other two triple charge batteries, one after another, for 4.5 hours each, using the Fast Charger with one of the car batteries. The green LED light on the fast charger will light up when charge is complete. *NOTE: it is important to disconnect the fast charger from the batteries at this time; otherwise, it will continue to draw current and reduce the available energy in the car battery.*
2. After 10 charges with the first car battery, take it for recharging, preferably to a place with access to an electric line. If none is accessible, use a vehicle to recharge the battery. (Follow parameters outlined above). Meanwhile, use the second car battery for recharging the triple charge pump batteries.

NOTE: In the event of a “bad”/defective triple charge battery (unlikely, but possible!): The fast charger can be used *while the pump is running during monitoring.* Connect the fast charger directly to the battery in the pump (has adaptor plug). This will take longer than when the triple charge battery is not in use, likely 6 hours. *Remember to disconnect the charger as soon as the green light turns on to save the car battery’s energy!*

Other topics affecting monitoring schedule:

- Consistency of start time (see section III). The start time should remain as consistent as possible from house to house. However, it will not be possible to start exactly at the same time every day, due to transition time between houses, pump calibration, etc. It is recommended that the start time remain within approximately a 1 hour bracket, prior to breakfast or first lighting of the fire. For example, if the first lighting of the fire typically happens at 6AM, the monitors should ideally be installed and started between 4:30 and 5:30AM (or as early as 4AM if necessary, or as late as 5:45AM, before lighting of fire).
- Pump calibration. See instructions in Appendix C.

V. Filter Cassette and Cyclone Preparation

1. Refer to Appendix B for proper filter and cassette assembly.
2. Record the two cassette serial numbers that you have selected onto the data form.
3. Check that for each cassette the plastic clip is in place and the cassette bag sealed (“ziplock” bags recommended): record this information on the data form.
4. Place the cassettes (in their bags) in the equipment case: the cassettes for the two periods will be inserted into the cyclone in the field.
5. Make sure you include in the equipment case the **same cyclone that you calibrated the pump with.**
6. **ENSURE THAT THE CYCLONE GRIT CAP AND INTERIOR ARE CLEAN.**

VI. CO Monitor Preparation

Before sampling for the first time:

1. Click on DataLink logo on computer screen desktop to open program.
2. Check room CO- monitor is OFF.
3. Put monitor into cradle, making sure the three dots on the monitor line up with three points on the cradle & monitor clicks into position.
4. Click “Connect to the T82,” then click on ON – monitor will beep once.
5. Click “check/set instrument settings.”
6. Click “change.”
7. Click TWA time base and change to 24 hours and set Lo, Hi, TWA, and STEL alarms to 999.
8. Click “set” – wait for set of blue bars to show it has been done.
9. Click “Exit.”
10. Click “Clear data.”
11. There is no need to open the “Download preferences” as they should be left as set currently.
12. Click “disconnect.”
13. Click “exit.”

| |
|-------------------------------------------------------------------------------|
| >>>Performing a zero check at supervisor’s office<<< |
|-------------------------------------------------------------------------------|

1. Switch on the instrument.
2. Ensure that the air around is clean and/or keep the inlet tightly covered.
3. Observe if the display is showing zero.

VII. Equipment Set-up

A. *PM monitor set-up*

1. Record serial number of cassette on Data Collection Form (Step 3) and on household correlation table. *It is vital that this information is recorded correctly as this is the only way of knowing which sample comes from which house.*
2. Check chart provided in Appendix A of this manual for the filter cassette serial numbers for each house.
3. Select the filter cassette with the correct number for the first monitoring session (should be prepared ahead of time).
4. Enter the filter cassette serial number onto the data collection form.
5. Remove the plastic clip, replace clip in bag and reseal the bag. Place the cassette into the cyclone the right way up (the word “TOP” is printed on the top), and close the cyclone securely, without over-tightening.

Positioning the pump and cyclone:

1. Connect cyclone to pump, and ensure cyclone lid securely tightened, and pipes well connected.
2. Identify a suitable site for the **cyclone**. This must be in the kitchen, **1.3m above floor level, and 1.3m from fire, and away from smoke rising directly from fire**. Avoid a location that is close to (less than 1 meter away from) windows, doors, and other openings.
3. When you have identified a suitable location, fix the pump and cyclone securely. Ensure that the cyclone is upright. Check alignment of the filter holder and cyclone in the sampling head to prevent leakage.
4. Record the location on the data collection form, **providing enough detail to ensure that the same location can be selected for all subsequent rounds of air pollution monitoring**. Put an “X” on the layout drawing for the kitchen to identify the location of the monitor.

B. *CO monitor set-up*

1. The T82 room monitor should be fixed securely next to the cyclone.

VIII. Equipment Start-up

A. *Starting the pump for sampling PM*

The pump has been prepared and calibrated by the supervisor, and should be ready to start sampling.

- Switch on the pump in the RUN mode by pressing “ON” and then “ENTER.”
- Record the temperature displayed by the pump.
- Check that the flow rate is in the range **2090 – 2310 ml/minute**.
 - > If flow rate is in range, proceed.
 - > If flow rate is not in range, the pump must be re-calibrated by the supervisor (see Appendix C for pump calibration procedure).

B. *Sampling CO*

- Switch on T82 CO monitor by pressing and **holding the switch until it gives one beep**, and watch to see that the display goes through the following sequence:
 - > “On”
 - > CO – this is what is it going to measure
 - > A series of bars to show the condition of the battery in a 3-2-1 pattern (if it is less than 3-bars, let the IAP consultant know at once)
 - > r 2.2 – this is the software which is needed to download the measurements
 - > A red light and backlight to the display
 - > A countdown set of numbers: 5-4-3-2-1
 - > It will then indicate the level of CO in the room (which may be zero, so do not be concerned if it shows 0...the important thing is that there is a number on the screen). It is now working.

IX. Mid-Monitoring Filter Change and Equipment Check

A. Filter replacement

If all has gone well, all that is required following the first monitoring session is to check the pump, replace the filter cassette, and then re-start the pump.

NOTE:

1. While replacing the filter cassette always hold the cyclone upright and **never invert the cyclone at any time.**
2. If the pump has stopped before you arrive, it is important to find out why.

The following procedure should be followed:

Procedure for checking and then temporarily stopping the pump

Case 1: If pump is **still running**, follow the steps below.

1. Record the following:
 - ❑ Flow rate
 - ❑ Temperature
 - ❑ Time elapsed (minutes)
 - ❑ Total volume sampled (liters)
2. Then press ON/HOLD (for a few seconds).
3. Remove the filter cassette. While replacing the filter cassette always hold the cyclone upright and **never invert the cyclone at any time.** Put the sealing clip on the cassette, then place the cassette into the plastic bag and close the seal.
4. Locate the second filter cassette and enter the serial number on the form. As you did for the first cassette at the start of monitoring, remove the plastic clip, replace this in the bag, and re-seal the bag. Place the cassette into the cyclone the correct way up (see reminder box), and close the cyclone securely without over-tightening.

| |
|-----------------------------------------------------------------------------|
| Make sure the cassette is the correct way up! [“Inlet” and “Outlet”] |
|-----------------------------------------------------------------------------|

5. Press “ENTER” again to restart for the second session.

Case 2: If pump has **stopped running**, proceed as follows:

1. Check display. The reason for pump stoppage should be displayed (e.g. “flow interrupt” if the filter is blocked). If the display has gone, you will need to press ON/HOLD.
2. Record the reason for the pump stopping.
3. Record the data displayed on: **Time Elapsed and Total Volume Sampled**.

NOTE: If the pump has stopped, the monitoring in that house should be abandoned and the pump taken back to the field office to be checked thoroughly, and to establish exactly what the problem has been. Advise the householder that you are making checks on the equipment, and with her permission you would like to arrange to repeat the sampling on another day. Please ensure that she does not think that she is in any way responsible for problems such as these.

B. Check CO monitors

Make sure that the kitchen CO monitor is still working by checking that there is a value on the display (this may be zero – that is OK). **Do not make any adjustments** to the CO monitors.

X. Equipment Shut-down, Data Recording, and Recalibration

A. Checking and then stopping the PM pump

If pump is still running:

1. Record:
 - Flow rate
 - Temperature
 - Time elapsed (minutes)
 - Total volume sampled (liters)
2. Stop pump by pressing “ON/HOLD” for a few seconds then pressing “OFF” again for a few seconds.
3. Do not switch on pump for any reason until reviewed by the supervisor.
4. Ensure that the filter cassette is stored and transported with exposed side up and does not suffer any shocks (to the extent possible).
5. Proceed to “flow rate measurement...” section C below.

If pump has stopped running: the reason should be displayed (e.g. “flow interrupt” if the filter is blocked).

1. If the display has gone, you will need to press ON/HOLD.
2. Record the reason for the pump stopping.

NOTE: If the pump has stopped, the monitoring results in that house will not be used. The pump will need to be checked to establish exactly what the problem has been. Advise the householder that you are making checks on the equipment, and with her permission you would like to arrange to repeat the sampling on another day. Please ensure that she does not think that she is in any way responsible for problems such as these.

B. Switching off the T82 CO monitor:

1. Depress and hold down the function switch on the room CO monitor **until the instrument beeps 5 times**. Check that the display is now blank. The machine is now off.

C. Data download from CO monitor (Steps 7 & 8 of the data collection form):

1. Check room CO- monitor is OFF
2. Put monitor into cradle, making sure the three dots on the monitor line up with three points on the cradle & monitor clicks into position & beeps once.
3. Click “Connect to the T82” – monitor will beep once. You will see “Communication link with instrument is established.”
4. Machine will indicate “1 session available to download” – click on “Download data.”
5. You will be asked to give the file a name. Give a name and save the file. **Do not clear at this stage.**

6. Click on Disconnect. You will see “instrument data were not cleared (1 session). Do you wish to do so before exiting?” Click “NO.”
7. Then “file open” and check that the data is there, and that the date and the times are those that you expected them to be for the house (s) you monitored. You will find this by opening the “Summary/Comments” page (which is the first icon on the left of the opened file).
8. Once you are **absolutely sure that you have downloaded all the data successfully** – connect the T82 Datalogger again.
9. Click “Clear data.”
10. Click “disconnect” - monitor will beep once.

BACKUP

11. **Please remember that this is the only record that we have of CO levels.**
12. Click on “File open” – highlight the file you have just created.
13. Right-click and select “Send to” and choose 3½ Floppy (A).
14. Save onto a labeled floppy disc.

D. Flow rate measurement and filter cassette handling on completion of monitoring (Step 6 of the Data Collection form)

1. Connect the **calibration cassette** between the pump and calibrator. Press ENTER and RUN.
2. Switch on calibrator and wait for 2 minutes for pump flow rate to stabilize. In the meantime wet the glass chamber with many bubbles.
3. Take 3 readings of the flow rate.
4. Switch off pump by pressing ON/HOLD and later OFF.
5. **THIS IS THE END OF THIS SESSION.**
6. Clean the cyclone grit cap and the interior of the cyclone by unscrewing the 4 screws.

NOTE: The most important checks that you need to make on the filter cassettes when these are brought back from the house are:

- **You have the correct cassettes for the house just sampled.**
- **The cassettes are correctly sealed with the plastic clip and bag.**

Accordingly, inspect the cassettes and:

7. Record (a) the number, and (b) the condition and packing of the cassette on the data form.

Checking Interviewer Data Collection Forms (Step 9 on the data collection form)

At the end of each house visit (for interview and monitoring), the supervisor should check through the forms that have been completed by the Interviewer. Check that all fields have been

completed (that is, none have been omitted), and that the entries appear correct and consistent.

All omissions and possible incorrect entries must be checked with the interviewer, and corrected. If there is any uncertainty about an entry, a return visit to the house should be made by the supervisor should be made.

Record checks on the forms, together with remedial action taken for corrections.

XI. Post-Monitoring Questioning

These questions will be asked **after the completion** of the air monitoring. All questions refer to what happened **during** the time that the monitors were measuring smoke.

➤ Cooking meals

Note that these questions refer only to the preparation of meals for the family, not the preparation of food or other products for sale, or for any other uses (see section below if this applies).

➤ Timing of meal

Please note that information collected on the first meal refers to the first meal after the monitors were set up and started working and NOT necessarily the first meal of the day (in the event that 12hr/12hr monitoring sessions need to be used). Similarly questions are asked about the second, third, and fourth meals (where appropriate) after the monitors were set up and started working.

For Questions H 1.3 and H 1.4, record approximately how long it took to cook (to nearest quarter of an hour, if possible).

➤ Types of food and drink cooked

Please record food using local names, also hot drinks prepared for the mealtime. We may need some guidance on how the types of food should be recorded (hard/soft, etc.) and in what detail for this to be used in an effective way in the analysis.

➤ Other uses of the fire/stove

This question is to be used for use of the fire/stove in the preparation of food or other products for sale, or for any other use.

If food and/or other products were prepared at the same time as one or more of the meals for the family, try to find out how much of the fuel used on the day of the monitoring was used in income-generating and “other” activities. This will show how important fuel is to people’s earning power.

➤ Time-activity information

In this case, air pollution monitoring began at 08.00 hrs (8 o’clock in the morning). The fire was not lit until 5.30 AM, and went out at about 10.00 AM. It was lit again at 1.00 PM, and was kept alight (smoldering) during the afternoon, until cooking began again at 5.30 PM. The fire was used for cooking and sitting round in the evening, and finally went out at (probably) 1 AM when the family was asleep – in this case the mother and child were sleeping in the same room as the fire.

➤ **Comments and observations**

From the INTERVIEWEE

Ask if the interviewee has any more comments that she would like to add about the issues that you have discussed, or related issues. If the interviewee does not obviously have more to add, there is not need to press her for further comments.

From the INTERVIEWER

Record here any observations you wish to make about the interview, and any other relevant observations.

PLEASE TAKE CARE TO ENSURE THAT NO EQUIPMENT HAS BEEN LEFT AT THE HOUSE.

APPENDIX A. Chart for correlating filter cassette serial numbers with households

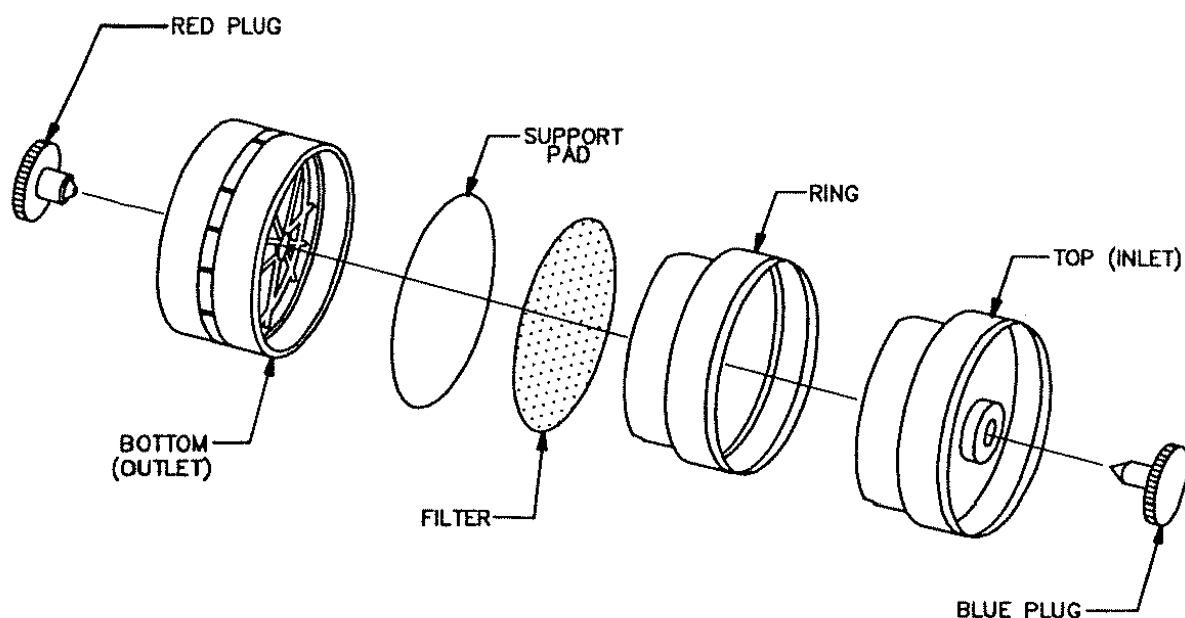
Chart: Household Numbers, Name of Cook and Identifier and Serial Number of Cassette

[illegible]

APPENDIX B: Filter cassette configuration diagram

37mm Filter Cassette Configurations

Zefon offers 37mm cassettes as convenient pre-loaded and assembled units that are ready to use OR as empty cassettes that can be loaded with the filters of your choice. They are manufactured in numerous plastic housing materials and have a large selection of compatible filters. The two most common styles are the 2 and 3 piece clear styrene models, the latter of which is highlighted below.



37mm 3-piece Cassette Configuration

3-piece cassettes can be used for both “open face” and “closed face” sampling as well as connect to cyclones. The main disadvantage would be that 3-piece cassettes have more static charge than 2-piece cassettes, resulting in more potential for sample loss.

The term “closed face” sampling refers to using a 37mm cassette with the inlet in place and only the plugs removed. Alternatively, “open faced” sampling refers to using a 3-piece cassette and removing the inlet piece, thus creating an “open face.”

APPENDIX C: Pump calibration procedure

PUMP PREPARATION AND CALIBRATION

Step 2 of the data collection form

Items required

- Calibrator
- Pump and power supply
- Tubing (2 lengths of ~0.5m)
- Cassette, containing clean filter (the calibration cassette)
- Cyclone

I. Preparation

Check that the calibrator has a *small amount* of soap solution (about 1 teaspoonful or 5ml) in the bottom of the glass cylinder (enough to cause a bubble to form around the glass). If not sufficient, top up through the lower tube (see Figure 1).



Figure 1: Place a few drops of soap solution into the bubble chamber through the lower opening.

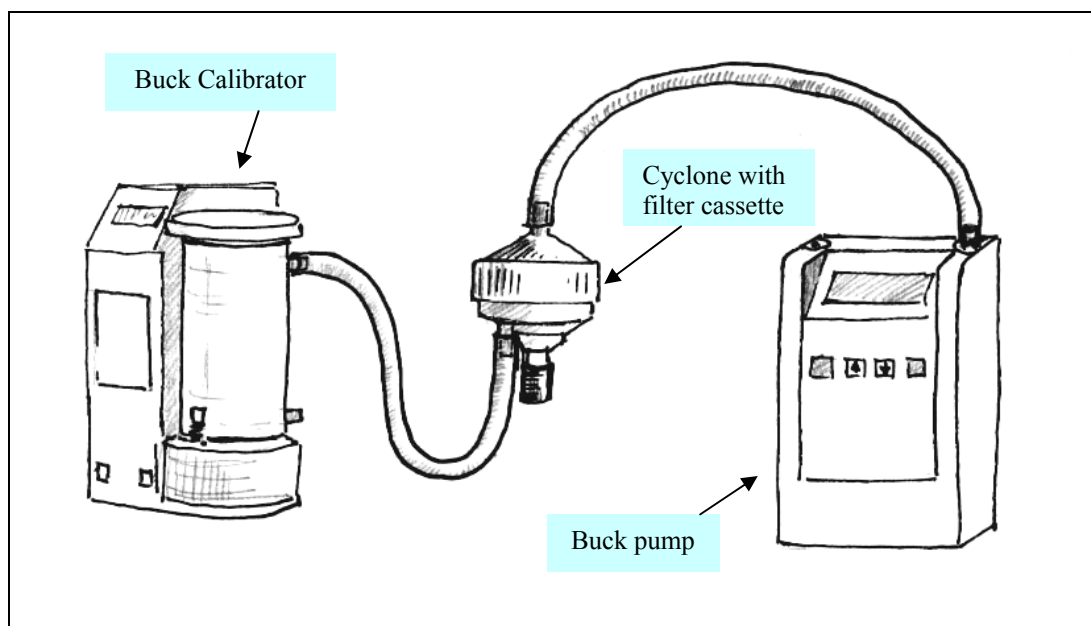


Figure 2: Connection of pump and cyclone to the Buck calibrator. The tube between the pump and cyclone should be the length normally used when sampling in the home, and the cyclone must have the (clean) **calibration** filter cassette installed.

1. Place the calibration cassette (with a blue tape) in the same cyclone assigned to the household being surveyed, ensuring it is the right way up. (TOP is shown on the cassette.) Remove and clean the cyclone's grit cap. Ensure that the cyclone lid is securely tightened to avoid leaks (but do not over-tighten), and that the O-ring in the upper part of the cyclone is in place. Connect the cyclone outlet (top, horizontal pipe) to the pump, and the inlet (lower vertical pipe) to the Buck calibrator as shown (Figure 2). Note that the cyclone inlet should be connected to the upper tube on the calibrator (Figure 3).
2. Place the equipment on a flat stable surface.
3. Connect the pump to its power supply (+) to the red and (-) to the black. Note that the calibrator has an internal rechargeable battery, estimated operating time of 6-8 hours, and there is a low battery indicator. Battery should be kept adequately charged.



Figure 3: Tube to cyclone connects to upper outlet of calibrator.

II. Clear current pump settings:

4. Switch "ON" pump.
5. Move arrow to RESET and press ENTER.
6. Sampling data to be cleared? Use arrow to YES and press ENTER. (You will see "sampling data erased.")
7. Run battery life: No. Press ENTER.
8. Menu goes back to initial display.

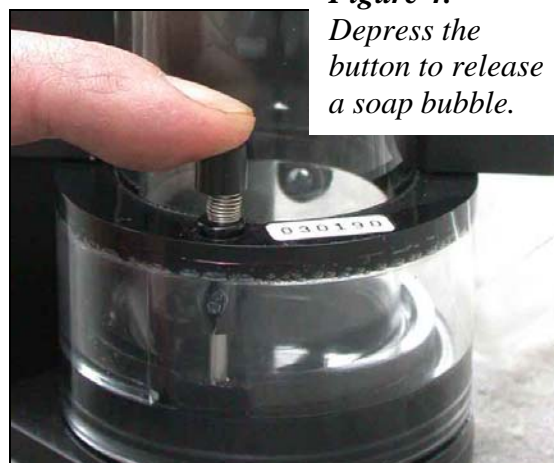


Figure 4: Depress the button to release a soap bubble.

III. Check and calibrate the pump flow rate:

9. Move arrow to calibrate "CAL."
10. Clear current calibration – move arrow to YES and press ENTER.
11. Warning "Will Erase." Move arrow to YES and press ENTER.
12. You will hear the pump run.
13. If display shows 2200 press ENTER. If display is not showing 2200, then use arrows to change it to 2200. This is our target flow rate.
14. Switch on the Buck calibrator unit. Display should show 0000.
15. Keep pump running for 2 minutes to allow it to stabilize.
16. In the meantime, wet the glass chamber by releasing many bubbles (Figure 4 and Figure 5).



Figure 5: Soap bubble moving up the chamber. Make sure it reaches the top freely before starting measurements.

17. After 2 minutes are over, check the flow rate of the pump as follows:
- Release a bubble to obtain a reading on the calibrator and record this on a paper. Repeat until you obtain **THREE CONSECUTIVE READINGS** all within 100ml (0.1 on the calibrator display).
 - Wait until the calibrator display stops flashing before releasing the next bubble).
- NOTE: The readings on the calibrator are in liters/minute – please ignore the decimal point to produce readings in ml/minute (e.g., 2.197liters/minute =2197ml/minute). An example is given in Table S1 (below):

Table S1: 3 Consecutive flow rates meeting calibration criteria

| Reading | Value (ml/minute) | |
|---------|-------------------|-------------------------------------------|
| 1 | 2186 | These are <i>acceptable</i> results |
| 2 | 2204 | |
| 3 | 2193 | |

Set the pump to the correct flow rate if it is not already doing so:

18. The criteria for a correct flow are that the average of the 3 measurements should be close to **2200 ml/minute**, and that all three **must be in the range 2090 to 2310** ml/minute. Fill up section 5, 6, 7 of the supervisor manual.
19. If the criteria for the flow rate **ARE ACHIEVED** (Step 14), adjust the flow rate display (see Section IV, below – “Adjusting the Display”).
20. If the criteria for the flow rate are **NOT ACHIEVED** (Step 14), and an example where criteria are not met is provided in Table S2, adjust the flow using the UP and DOWN arrow keys on the pump. You will hear the pump slowing down or speeding up and see the % change on the display. Allow 20-30 seconds for the pump to stabilize after each change you make in the flow rate. Carry out a further three test readings with the calibrator, and check whether these meet the criteria. This procedure needs to be repeated, by “trial and error” until the criteria are met.

Table S2: 3 Consecutive flow rates NOT meeting calibration criteria

| Reading | Value (ml/minute) | |
|----------------|-------------------|----------------------------------------|
| 1 | 2103 | These results are NOT acceptable |
| 2 | 2086 | |
| 3 | 2135 | |
| Average | 2108 | |

21. Note that the final three readings (that you enter on the data sheet) must be within 20ml/minute of each other. If this precision cannot be achieved, check all connections, and that the grit pot is in place on the cyclone. If this level of consistency is still not achieved, contact Dr. Subida and we will get in touch with suppliers.

IV. Adjusting the display on the pump:

22. Press ENTER. You will see “Calibration flow rate 0000 cc/m.”
23. You will now adjust the four-digit display on the pump to read the average of the final three readings, which have been entered on the data sheet. Each digit will flash in turn, starting with the left hand one. Use the up and down keys to set the number. Press ENTER to move on to the next digit (which will then start to flash), until all are correct. Then press ENTER again – the pump will stop and menu goes back to initial main menu.
24. Press ENTER on RUN. Flow should be 2200. If not, use arrow to set it to 2200 and then press ENTER.
25. Switch off pump by pressing “OFF” for a few seconds. DO NOT SWITCH ON PUMP TILL ACTUAL MONITORING BEGINS.
26. The pump is now calibrated and ready for survey work.
27. Place the pump and cyclone (with calibration cassette removed) into the house survey kitbag.

APPENDIX D: CO datalogging “Datalink” procedure

Software Installation

1. Insert the CDROM that contains the software into the CD drive.
2. Invoke the SETUP.EXE installation utility.
Assuming that you are using CDROM drive D, choose Start | RUN and type the following at the command line in the Run dialog box, and select OK:

D:SETUP

The installation program prompts you for your installation preferences.

3. Respond to the prompts as appropriate.
The installation program decompresses the files and copies them to the specified drive and directory. Some of the files are copied to the system directory.

Running the DataLink Software

You can run the DataLink software by either double clicking the DataLink icon placed on the desktop or by choosing ‘Start | Programs | DataLink | DataLink’.

Downloading, Clearing and Setting the Instrument

Use the following procedures to download the logged data, to clear the logged data or to set the instrument:

1. Connect the DataLink cradle (for the T82) or the Charger/DataLink (for the ITX) to any of the available COM port on the back of the PC. You may leave it connected to the PC.
2. Place the T82 on the DataLink cradle or connect the ITX to the Charger/DataLink.
3. Click on the ‘Connect to the T82 / ITX...’ button in the main screen.
4. Follow the instructions as shown on the computer screen to establish communication with the instrument. Once the communication with the instrument is established, the interface menu will be displayed.
5. From the interface menu, you can select to download the data, clear the data or to check/set instrument settings.

Important!

The following procedures are recommended if you are connecting to the instrument for the first time and prior to log any data:

1. From the Interface menu, select the ‘Check/Set Instrument Settings...’
2. Examine the instrument settings. Click on the ‘Change’ button (for the T82) or the ‘Update’ button (for the ITX) to change any of the settings if necessary.
3. Click on the ‘Exit’ button to go back to the Interface menu.
4. Select the ‘Clear Data...’ to clear the data stored in the instrument.
5. The instrument is ready to log data.

Viewing Instrument Data and the Data Summary

1. Click on the ‘File Open...’ button in the main menu.
2. Select the file that contains the data you wish to view.
3. From the spreadsheet menu, select ‘File | Summary/Comments’ or click on the data summary icon (the first icon in the toolbar) to view and/or print the data summary.

Viewing Data Graphics

1. From the spreadsheet menu, select ‘Graphics’ then select an item. All the data stored in the file for that item will be plotted.
2. Perform the following 2 steps, not necessarily in that order, if you wish to plot a part of the displayed data:
 - 2.1. From the spreadsheet menu, select ‘Graphics | Manually select...’ or right click on the spreadsheet and select ‘Graphics | (Manually select)...’ from the popup menu.
 - 2.2. Highlight the data you wish to plot and click on the ‘Next >>’ button. Do not select data from the time column. The time will be automatically selected.

** Refer to the help file for more information on using the DataLink Software.*